

What is claimed is:

1        1.    A method comprising:  
2                using a four-membered ring of alternating  
3    nitrogen and silicon atoms as a silicon precursor to form a  
4    silicon nitride film.

1        2.    The method of claim 1 further including using a  
2    nitrogen precursor to form a silicon nitride film.

1        3.    The method of claim 1 further including using  
2    said silicon precursor at a temperature less than  
3    approximately 500°C.

1        4.    The method of claim 1 including using a four-  
2    membered ring comprising the general formula:  
3                                 $[R_2SiNR]_2$ ,  
4                where each R is selected from the group  
5    consisting of a hydrogen, a halogen, an amine, an alkyl, an  
6    aryl, a silyl and an organic group having one to  
7    approximately twenty carbons.

1        5.    The method of claim 1 including using a  
2    halogenated cyclodisilazane.

1        6.    The method of claim 1 including using an amine  
2    substituted cyclodisilazane.

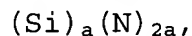
1           7.    The method of claim 1 including using  
2 cyclodisilazane including an organic group containing one  
3 to approximately 20 carbon atoms.

1           8.    The method of claim 2 including using a nitrogen  
2 precursor selected from the group consisting of ammonia,  
3 hydrazine and a substituted hydrazine.

1           9.    The method of claim 2 including combining said  
2 nitrogen precursor and said silicon precursor in a premixed  
3 cocktail with an optional solvent.

1           10.   The method of claim 1 including forming a silicon  
2 nitride film tuned to have a specific impurity profile.

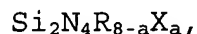
1           11.   A method comprising:  
2                using a silicon precursor to form a silicon  
3 nitride film, said silicon precursor being a substituted  
4 ring comprising the general formula:



6                where silicon is bound to two nitrogens,  
7                where said nitrogens are bound to said silicon  
8 and nitrogen, and  
9                where a is an integer greater than or equal to  
10 one.

1        12. The method of claim 11 including using 1,2,4,5-  
2        tetraaza-3,6-disilacyclohexane as the silicon precursor.

1        13. The method of claim 11 including using a silicon  
2        precursor comprising the general formula:



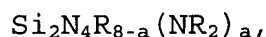
4        where X is a halogen,

5        where each R is selected from the group  
6        consisting of a hydrogen, a halogen, an amine, an alkyl, an  
7        aryl, a silyl and an organic group having one to  
8        approximately twenty carbons, and

9        where a is an integer less than or equal to  
10       eight.

1        14. The method of claim 11 including using a  
2        halogenated derivative of 1,2,4,5-tetraaza-3,6-  
3        disilacyclohexane as the silicon precursor.

1        15. The method of claim 11 including using a silicon  
2        precursor comprising the general formula:



4        where each R is selected from the group  
5        consisting of a hydrogen, a halogen, an amine, an alkyl, an  
6        aryl, a silyl and an organic group having one to  
7        approximately twenty carbons, and

8        where a is an integer less than or equal to four.

1        16. The method of claim 15 including using a silicon  
2 precursor selected from the group consisting of 3,6-  
3 bis(dimethylamino)-1,4-ditertiarybutyl-2,5-dimethyl-  
4 1,2,4,5-tetraaza-3,6-disilacyclohexane and 3,6-  
5 bis(tertiarybutylamino)-1,4-ditertiarybutyl-1,2,4,5-  
6 tetraaza-3,6-disilacyclohexane.

1        17. The method of claim 11 including using a silicon  
2 precursor comprising the general formula:  
3 
$$\text{Si}_2\text{N}_4\text{R}_8,$$
  
4        where each R is selected from the group  
5 consisting of a hydrogen, a halogen, an amine, an alkyl, an  
6 aryl, a silyl and an organic group having one to  
7 approximately twenty carbons.

1        18. The method of claim 17 including using a silicon  
2 precursor selected from the group consisting of 1,2,4,5-  
3 tetratertiarybutyl-1,2,4,5-tetraaza-3,6-disilacyclohexane,  
4 3,6-divinyl-1,4-ditertiarybutyl-2,5-dimethyl-1,2,4,5-  
5 tetraaza-3,6-disilacyclohexane, 3-phenyl-1,4-  
6 ditertiarybutyl-1,2,4,5-tetraaza-3,6-disilacyclohexane,  
7 1,2,4,5-tetramethyl-1,2,4,5-tetraaza-3,6-disilacyclohexane,  
8 and 1,2,3,3,4,5,6,6-octamethyl-1,2,4,5-tetraaza-3,6-  
9 disilacyclohexane.

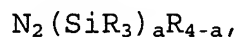
1        19. The method of claim 11 further including using a  
2        nitrogen precursor selected from one of ammonia, a  
3        hydrazine or a substituted hydrazine.

1        20. The method of claim 19 further including  
2        combining said silicon precursor and said nitrogen  
3        precursor in a premixed cocktail with an optional solvent.

1        21. The method of claim 11 further including forming  
2        said silicon nitride film at a temperature less than  
3        approximately 500°C.

1        22. A method comprising:  
2                combining a silicon source precursor comprising  
3        hydrazine including at least two silyl substitutions and a  
4        nitrogen precursor; and  
5                forming a silicon nitride film.

1        23. The method of claim 22 including combining a  
2        silicon source precursor comprising the general formula:



4                where each R is selected from the group  
5        consisting of a hydrogen, a halogen, an amine, an alkyl, an  
6        aryl, a silyl and an organic group having one to  
7        approximately twenty carbons, and  
8                a is two, three, or four.

1        24. The method of claim 22 including combining a  
2 silicon source precursor selected from the group consisting  
3 of 1,2-disilylhydrazine, 1,1,2-trisilylhydrazine, 1,1,2,2-  
4 tetrasilylhydrazine, 1,2-bis(trimethylsilyl)-1,2-  
5 ditertiarybutylhydrazine and 1,2-bis(trimethylsilyl)-1,2-  
6 diphenylhydrazine.

1        25. The method of claim 22 including combining said  
2 silicon source precursor and a nitrogen precursor from the  
3 group consisting of ammonia, hydrazine and a substituted  
4 hydrazine.

1        26. The method of claim 25 further including  
2 premixing said silicon source precursor and said nitrogen  
3 precursor in a cocktail with an optional solvent.

1        27. The method of claim 22 including tuning said  
2 silicon nitride film to have a desired impurity profile.

1        28. The method of claim 22 further including heating  
2 a deposition reaction chamber to a temperature that is less  
3 than approximately 500°C.

1           29. A system comprising:  
2           a chamber; and  
3           a silicon source coupled to said chamber, said  
4 silicon source for use as a silicon precursor selected from  
5 the group consisting of a four membered ring of alternating  
6 silicon and nitrogen atoms, a silyl substituted hydrazine  
7 comprising at least two silyl substitutions, and a compound  
8 having a substituted ring comprising the general formula:  
9                                $(\text{Si})_a(\text{N})_{2a}$ ,  
10           where silicon is bound to two nitrogens,  
11           where said nitrogens are bound to said silicon  
12 and nitrogen, and  
13           where a is an integer greater than or equal to  
14 one.

1           30. The system of claim 29 further including a  
2 nitrogen source for a nitrogen precursor coupled to said  
3 chamber.

1           31. A silicon precursor comprising a four-membered  
2 ring of alternating silicon and nitrogen atoms, said  
3 silicon precursor combined with a nitrogen precursor in a  
4 chemical vapor.





